

# Calorimeter Trigger Emulator

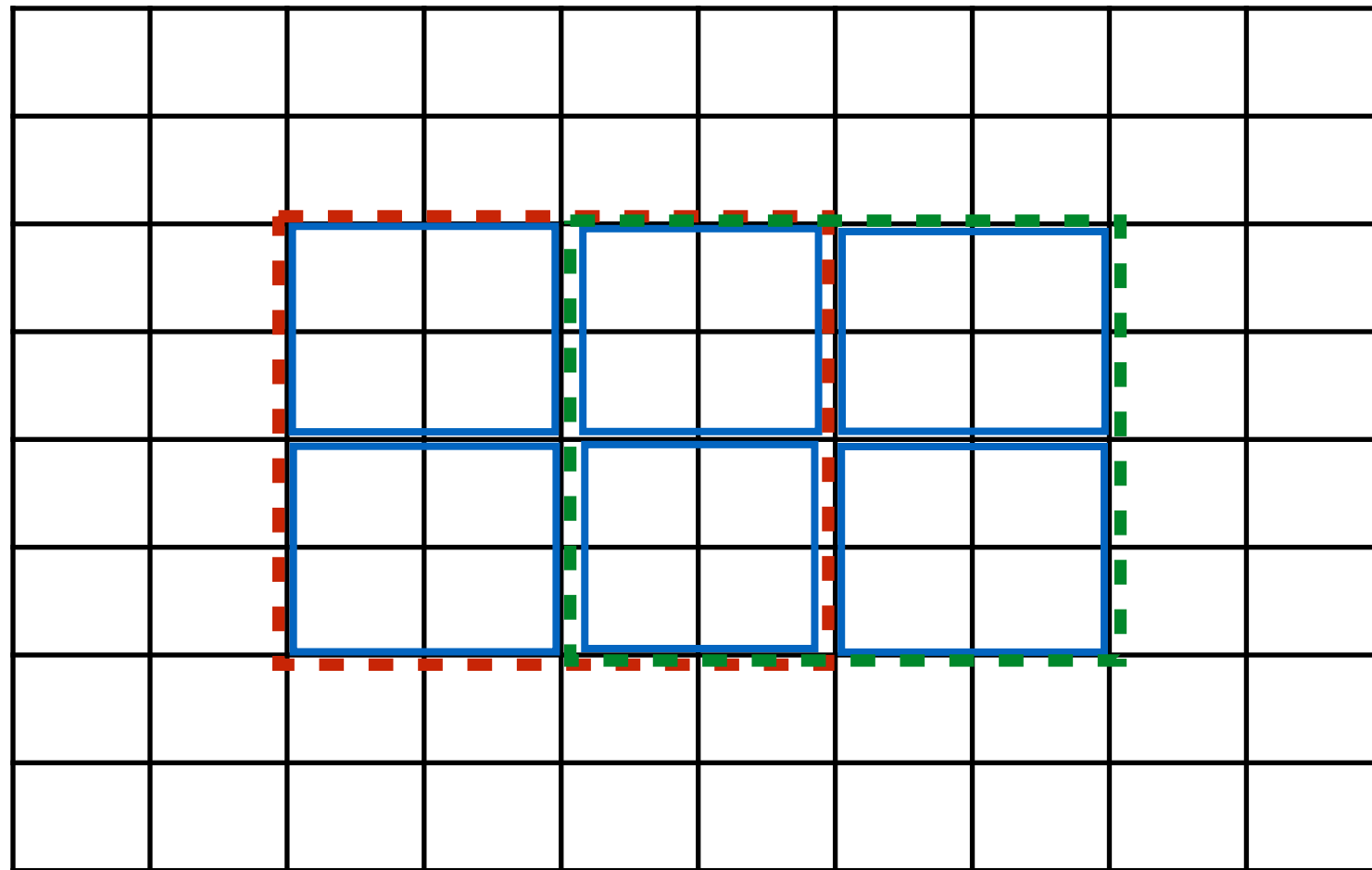
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# Overview

- Context: as Level-1 trigger is developed, need capability in sPHENIX software framework to study trigger performance
  - ➔ medium-range goal: trigger performance with latest sPHENIX geometry for CD-1 review
    - ➔ given bandwidth allocation and projected 5-year run plan & rates, can we achieve needed rejections & efficiencies?
  - ➔ rebooting work done for MIE proposal a few years ago (scattered over personal laptops) in a formal way
- CaloTriggerSim module: simulated 4x4 EMCal tower sliding window algorithm for single-cluster (e.g. Upsilon and photon) triggering
  - ➔ additional functionality such as  $N$ -bit ADC truncation, jet patch trigger, UE subtraction for jet trigger in Au+Au, etc. to be added
- CaloTriggerInfo module: lightweight storage of trigger information
- Git pull request: <https://github.com/sPHENIX-Collaboration/coresoftware/pull/274>

# Single Cluster Trigger



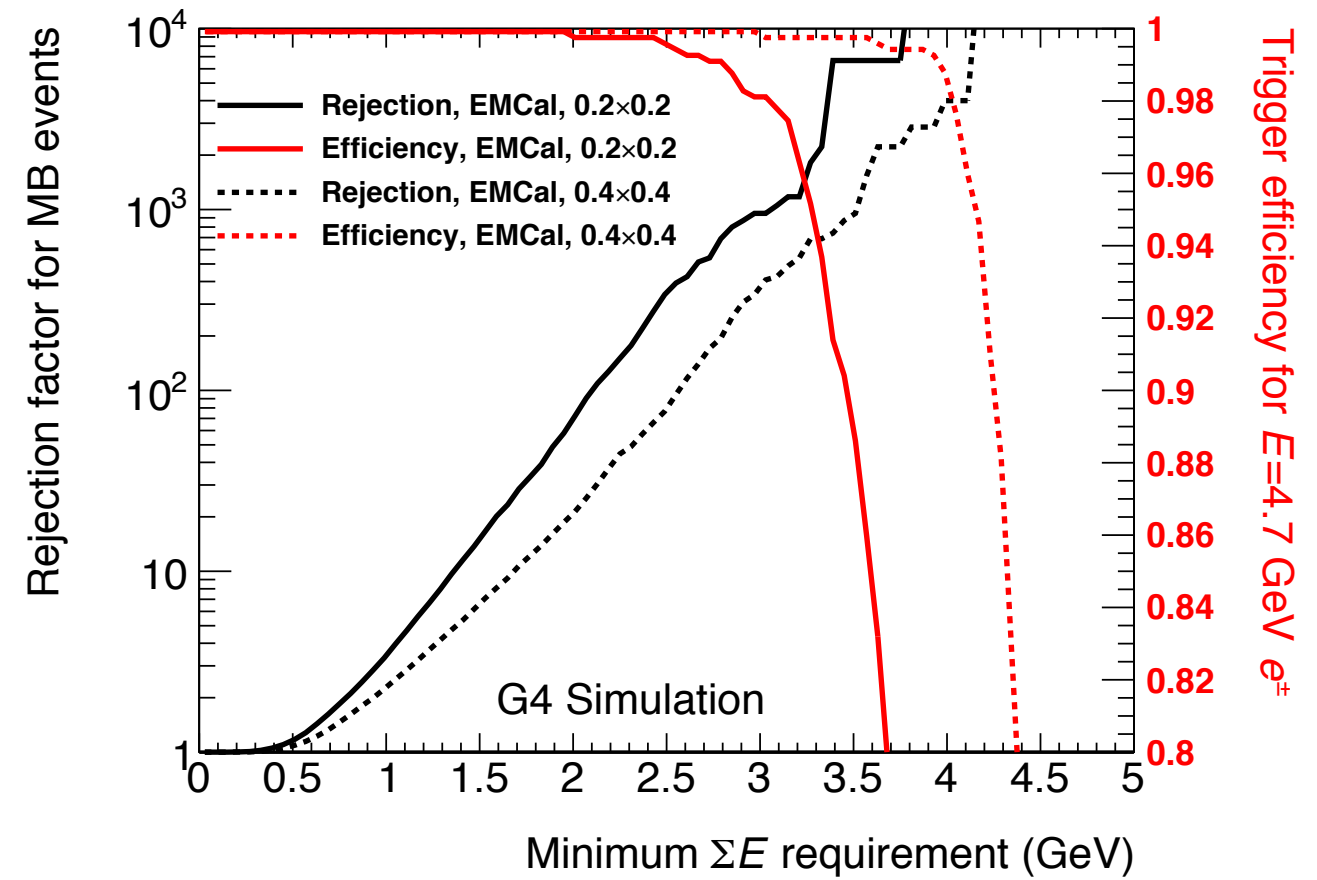
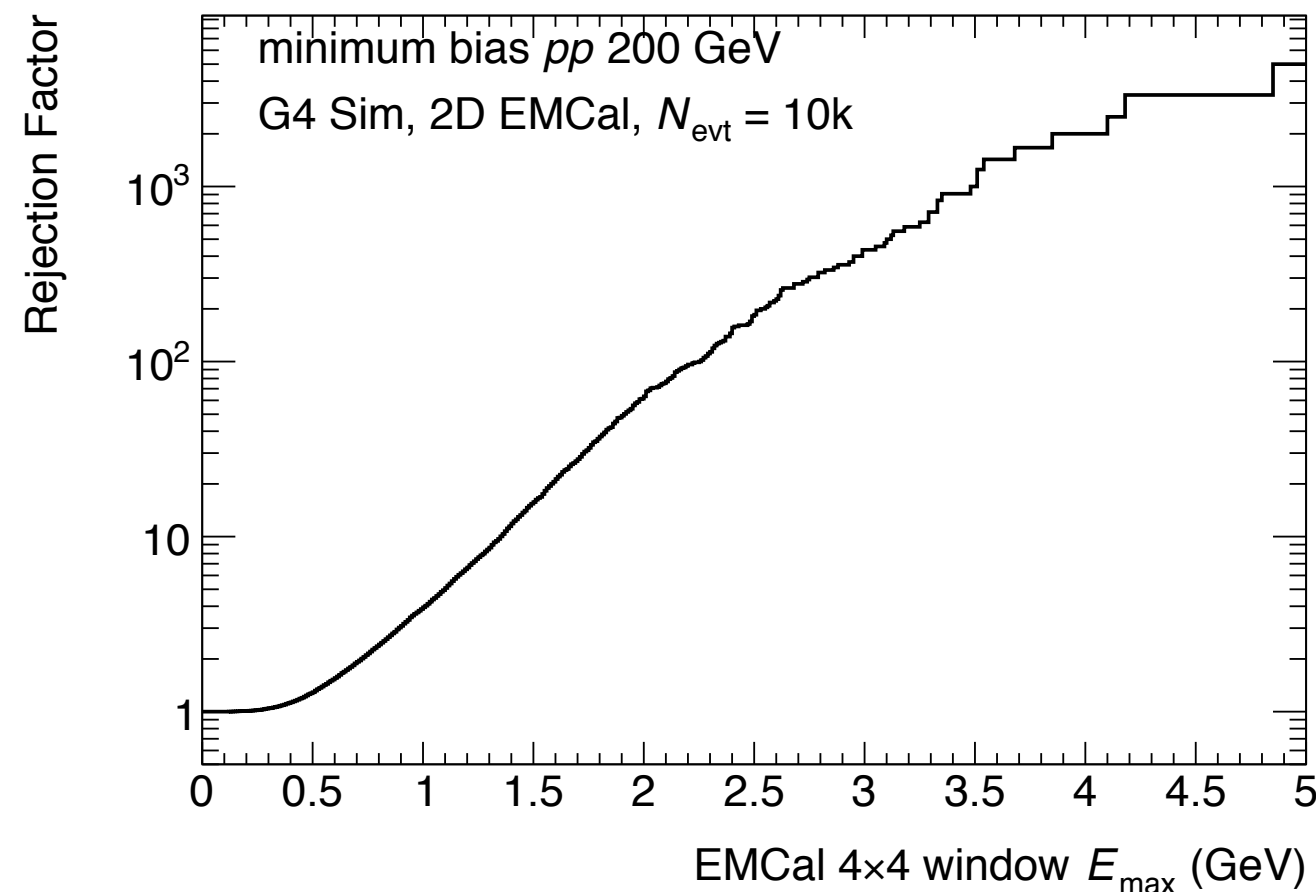
**EMCal towers (“1x1”)**

**non-overlapping 2x2  
tower windows**

sliding 4x4 windows  
built from 2x2 windows:  
example **#1** and **#2**

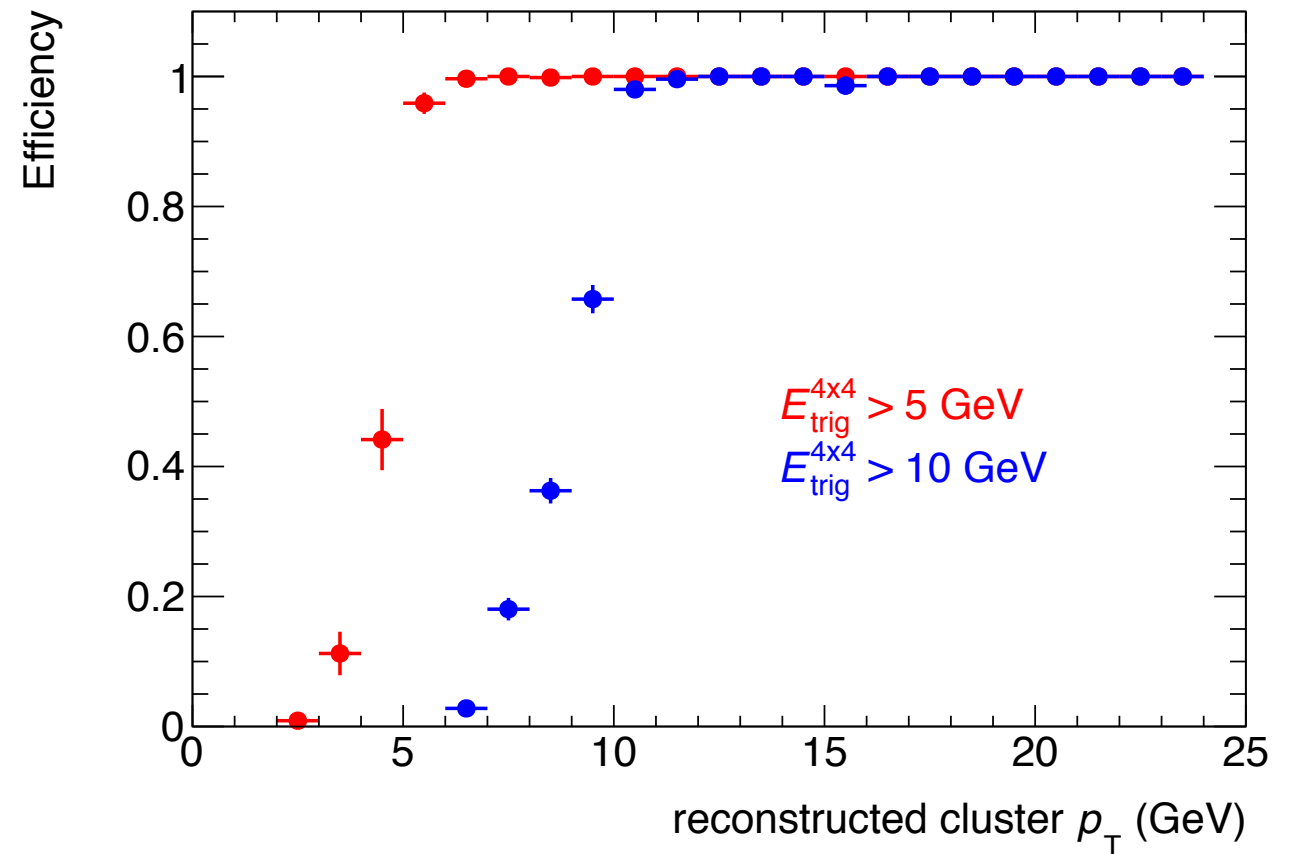
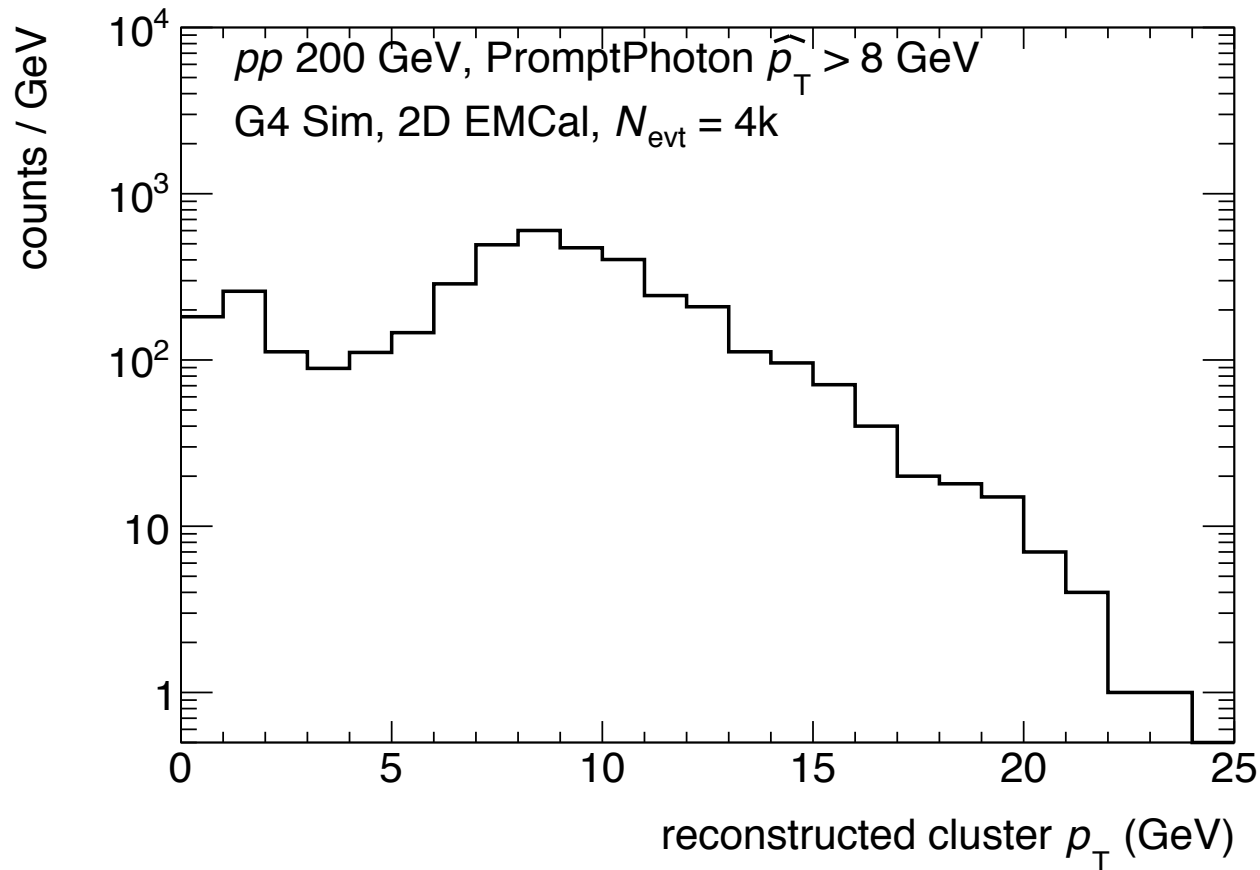
- Trigger emulator operates on calibrated EMCal tower energies
  - ➔ e.g. assuming we have “some” pedestal & gain correction at trigger level
- Conventional 4x4 sliding window algorithm operating on non-overlapping 2x2 windows

# Rejection in $pp$



- Tested with 10k Pythia8 events with SoftQCD:nonDiffractive = on  
 ➔ full G4 sim, 2-D EMCAL configuration
- Left: rejection factor vs. minimum 4x4  $E$  threshold
- Right: rejection factors in  $p+p$  from MIE proposal document, compare to **dashed-black** (Fig 3.32, Sec. 9, 1501.06197)

# Efficiency in $pp$



- Tested with 4k Pythia8 events with PromptPhoton:all = on and PhaseSpace:pTHatMin = 8.0 (and  $p_T^x > 5$  GeV,  $|\eta^x| < 1$  at gen-level)  
 ➔ full G4 sim, 2-D EMCal configuration
- Left:  $p_T$  of highest- $p_T$  reconstructed cluster in the event
- Right: efficiency as a function of reco cluster  $p_T$  for firing a  $E > E_{\text{min}}$  GeV trigger (two example values)